

1 REMARKS

2 Status of the Claims

3 Claims 1-8 and 10-36, and 38-58 remain pending in the present application, Claims 9 and 37
4 having been previously canceled. No amendment has been made in this response.

5 Brief Summary of Telephone Interview

6 On May 15, 2007, applicants' attorney discussed the current Office Action with Examiner
7 Shahrestani and his Supervisory Patent Examiner, Ms. Mantis Mercader, during a telephone interview.
8 Applicants' attorney appreciates Examiner Shahrestani's willingness to clarify his rejections in the latest
9 Office Action with respect to the specific agenda items on applicants' interview agenda.

10 With respect to Item 1 of the agenda, applicants' attorney asked Examiner Shahrestani to
11 identify the elements disclosed in U.S. Patent No. 6,485,413 (Boppart et al. – hereinafter referred to as
12 "Boppart") that are perceived as equivalent to applicants' waveguide and cantilever. The Examiner
13 explained that single mode optical fiber 58 in Boppart corresponds to applicants' recitation of "a
14 waveguide that conveys light from the light source within the cantilever. Applicants' attorney then
15 noted that step (c) of Claim 1 recites "a cantilever comprising a fixed end and a free end, the fixed end
16 remaining fixed to the substrate" and asked the Examiner where a fixed end and a free end are shown in
17 FIGURE 23a of Boppart. Examiner Shahrestani explained that he believes element 352 is equivalent to
18 the fixed end, and that the end opposite (where element 352 is disposed) is equivalent to the free end.

19 With respect to Item 2 of the agenda, applicants' attorney asked for clarification of which
20 elements Examiner Shahrestani believes are equivalent to applicants' recitation of a substrate that
21 serves as a support. The Examiner agreed that FIGURE 8d does not satisfy the functionality recited in
22 step (c) of applicants' claim, which provides that the cantilever has a fixed end that remains fixed to the
23 substrate. In FIGURE 8d, deflector 146 (on the substrate) is not illustrated as having a fixed end of the
24 cantilever fixed to it. Thus, it was pointed out that this particular embodiment is not an alternative
25 embodiment in Boppart that illustrates a substrate that serves as a support, as recited by applicants.

26 With respect to Item 3 of the agenda, Examiner Shahrestani clarified his remarks on page 2 of
27 the Office Action, wherein he stated that "... a MEMS device can be used to detect a difference in
28 electrical potential in place of another sensor." He further explained that U.S. Patent No. 6,563,998
29 (Farah) teaches a MEMS aspect and a MEMS that is a piezo-electric device. He explained that piezo-
30 electric devices are widely used, and that various sensors can be put in a MEMS device. Since Farah

1 refers to this type of sensor, Examiner Shahrestani indicated that it would have been obvious to one
2 skilled in the art to use a MEMS device for detecting a difference in electrical potential. No decision
3 regarding the patentability of the claims in this application was reached during the telephone interview.

4 Applicants' attorney would like to again thank Examiner Shahrestani and Ms. Mantis Mercader for
5 their time and willingness to discuss these issues during the telephone interview.

6 Claims Rejected under 35 U.S.C. § 102(e)

7 Claims 1-5, 8, and 10-19 remain rejected under 35 U.S.C. §102(e) as being anticipated by
8 U.S. Patent No. 6,485,413 (Boppart et al. – hereinafter referred to as “Boppart”). The Examiner
9 maintains that Boppart discloses each of the elements of the claims rejected. Applicants respectfully
10 disagree with this rejection for the reasons noted below.

11 In the interest of reducing the complexity of the issues for the Examiner to consider in this
12 response, the following discussion focuses on independent Claims 1, 20, and 43. The
13 patentability of each remaining dependent claim is not necessarily separately addressed in detail.
14 However, applicants' decision not to discuss the differences between the cited art and each
15 dependent claim should not be considered as an admission that applicants concur with the
16 Examiner's conclusion that these dependent claims are not patentable over the disclosure in the
17 cited references. Similarly, applicants' decision not to discuss differences between the cited art
18 and every claim element, or every comment made by the Examiner, should not be considered as
19 an admission that applicants concur with the Examiner's interpretation and assertions regarding
20 those claims. Indeed, applicants believe that all of the dependent claims patentably distinguish
21 over the references cited. Moreover, a specific traverse of the rejection of each dependent claim
22 is not required, since dependent claims are patentable for at least the same reasons as the
23 independent claims from which the dependent claims ultimately depend.

24 Patentability of Claim 1

25 Significant differences exist between the recited subject matter and cited art because the cited
26 art does not teach or suggest a cantilever with the functionality recited in subparagraphs (c), (c)(i),
27 and (c)(ii), and does not teach or suggest a photon detector, as recited in subparagraph (c).

28 Discussion of Cantilever's Functionality

29 It may be helpful to insert the elements disclosed in Boppart that the Examiner appears to be
30 asserting are equivalent to applicants' elements, into subparagraph (c) and subparagraph (c)(i).

1 Under "Response to Arguments," the Examiner has asserted that Boppart teaches a system that
2 includes a waveguide within the cantilever and that the waveguide undergoes transverse scanning. In
3 support of his assertion, the Examiner cites Figure 23a and column 34, lines 40-45, which are
4 reproduced below:

5 ...example of an extension of this technology to the optical probe unit of this
6 invention is to have a single-mode optical fiber 58 connected to an opto-electric
7 integrated circuit (OEIC) 352. This OEIC 352 contains one or a series of beam
8 dividers (not shown) which split the optical signal into N channels. The OEIC 352
may be made of silica on silicon ... (Boppart, column 34, lines 40-45.)

9 In addition, based on the telephone interview, Examiner Shahrestani clarified that the single-
10 mode optical fiber 58 is equivalent to applicants' "waveguide that conveys light from the light source
11 within the cantilever."

12 Replacing the word "waveguide" with this asserted equivalent element in subparagraph (c)(i)
13 that recites a portion of the functionality of applicants' cantilever, would yield:

14 a *single-mode optical fiber (58)* that conveys light from the light source within the
15 cantilever (i.e., when scanning the light onto the image plane to create the image);

16 In addition, replacing the word "cantilever" with the asserted equivalent element in
17 subparagraph (c) that recites additional functionality of applicants' cantilever would yield:

18 a *single-mode optical fiber (58)* comprising a fixed end and a free end, the fixed end
19 remaining fixed to the substrate and the free end extending freely relative to the
20 substrate, enabling the free end to bend and deflect in regard to the limited region of
21 interest, the bending of the *single-mode optical fiber (58)* scanning light onto an image
22 plane to create an image, wherein the *single-mode optical fiber (58)* is configured as
one of

23 However, notice Boppart does not teach or suggest that the *single-mode optical fiber 58* reads
24 on the further details recited in subparagraph (c), that is "...comprising a fixed end and a free end, the
25 fixed end remaining fixed to the substrate and the free end extending freely relative to the substrate,
26 enabling the free end to bend and deflect in regard to the limited region of interest." During the
27 telephone interview, applicants' attorney understood Examiner Shahrestani to assert that element 352
28 in Boppart corresponds to the fixed end of the cantilever and is also the equivalent of a substrate, and
29 that the end opposite element 352 is the free end.
30

1 Applicants respectfully disagree. Assuming element 352 in Boppart corresponds to a fixed
2 end, it should be noted that as recited in applicants' claim, the cantilever also includes a free end that
3 is able to bend and deflect and to scan light onto an image plane (as recited in step (c)). However, it
4 appears from FIGURE 23a, as labeled, that "TRANSVERSE SCANNING" is performed proximate
5 to the *fixed end* of element 352, by *phase shifters 356* (which do not move at all), and **NOT** by a free
6 end that is cantilevered to move in order to scan light onto an image plane. Thus, Boppart does not
7 teach or suggest all that is recited in this claim regarding applicants' cantilever.

8 In support of his assertion under the section entitled "Response to Arguments," the Examiner
9 has also cited column 11, lines 59-60 of Boppart, which recites that Fig. 4b translates the fiber/lens
10 unit with a piezoelectric cantilever 74 and that such a cantilever 74 bends when a voltage is applied
11 across the cantilever materials. However, as noted in an earlier Office Action response, applicants
12 point out that:

13 Clearly, fiber/lens unit 63 of Boppart is not part of a cantilever that scans by bending,
14 but instead, simply pivots about a pivot point 94 to scan in an arc. Figures 4b, 6b, and
15 7b of Boppart all show a cantilever arm 74 with a free end, but the free end of
16 cantilever arm 74 supports a GRIN lens that is coupled to the end of a single mode
17 optical fiber. The cantilever configuration of Boppart fails to meet the recitation of
18 subparagraphs (c)(i) and (c)(ii) of Claim 1, which recite that the cantilever is
19 configured as either "a waveguide that conveys light from the light source within the
20 cantilever, when scanning the light onto the image plane to create the image," or as "a
21 moving carrier for the light source that emits the light, the light source being mounted
22 on the free end of the cantilever and moving when scanning the light emitted by the
23 light source onto the image plane to create the image." Light is not conveyed by a
24 waveguide *within* cantilever arm 74 in Boppart, and Boppart fails to teach or suggest
25 that *a light source*, which emits light, might be mounted *on the free end* of cantilever
26 arm 74. Accordingly, for this further reason, it should be apparent that Boppart does
27 not teach or suggest a cantilever like that recited in applicants' Claim 1. (Office Action
28 Response, dated October 16, 2006, page 14.)

29 Discussion of Support's Functionality

30 During the telephone interview, after discussing the elements in FIGURE 23a that the
Examiner believes to be equivalent to applicants' cantilever and support, applicants' attorney also
discussed the Examiner's citation to a substrate in column 15, line 16, to clarify if the Examiner is
asserting that this citation provides an alternate element equivalent to applicants' support. It was
agreed that this citation is not directed to an equivalent; however, for the record, applicants have
explained below their reasoning.

1 Applicants "support" element serves several functions. As recited in subparagraph (e), the
2 photon detector is configured to receive light at a location that is proximate to it; as recited in
3 subparagraph (b), a substrate serves as a support; and, as recited in subparagraph (c), the fixed end of
4 the cantilever remains fixed to the substrate. Applicants' substrate 220 of FIGURE 3 is one example
5 of the substrate as recited by this claim. Thus, any element equivalent to applicants' support must
6 perform these functions that are recited in applicants' claim. On page 3 of the Office Action, the
7 Examiner has cited column 15, line 16 on page 3 of Boppart as teaching an equivalent to applicants'
8 substrate in subparagraph (b). This portion of Boppart discusses how the design illustrated in Fig. 6d
9 utilizes a two-dimensional miniaturized deflector 146, such as an electrostatic deflector that can be
10 micro-fabricated on semiconductor or other substrates, e.g., silicon MEMSs. Because there is no
11 deflector 146 present on Fig. 6d, it appears that this is a typographical error in Boppart. Instead,
12 Boppart may have intended to refer to the design as illustrated in Fig. 8d, which is the first drawing in
13 which deflector 146 appears. Applicants thank the Examiner for confirming this point during the
14 interview. For the substrate upon which the deflector 146 is fabricated (as illustrated in Boppart's
15 Fig. 8d) to be equivalent to applicants' substrate, which serves as a support as recited in
16 subparagraph (e), Boppart's substrate must also satisfy the additional recitation in applicants'
17 subparagraphs (c) and (e). Specifically, the photon detector must be proximate to the substrate, and
18 the fixed end of the cantilever must remain fixed to it. As pointed out in the interview and agreed by
19 the Examiner, there is no fixed end of a cantilever proximate to the substrate of Fig. 8d.

20 Discussion of the Photon Detector

21 In subparagraph (e) of Claim 1, applicants recite :

22 a photon detector configured to receive light at a location that is proximate to the
23 cantilever and to the support;

24 Applicants set forth the following argument in their response to the last Office Action and will
25 repeat it for the convenience of the Examiner in this response. Applicants disclose that a photon
26 detector can be included for monitoring the displayed image and/or measuring motion of the
27 cantilever scanner(s) (see page 12, lines 28-30 of applicants' specification). Also, in FIGURE 3,
28 applicants illustrate photon detectors 224a and 224b that are integrated onto substrate 220, to directly
29 receive light at a location proximate to the substrate and to the cantilever. In an alternative approach
30 shown in FIGURE 6A, applicants illustrate a flexible optical fiber 256 that directs the received light

1 through a coupler 258 to an optional semiconductor waveguide 260, which further directs the light to
2 one or more photon detectors 262 that are disposed proximally; however, the light is still received by
3 the distal end of flexible optical fiber 256 at a location that is proximate to the cantilever and
4 substrate, so that optical fiber 256 receives light reflected from a target 190.

5 Boppart does not teach or suggest any device equivalent to a photon detector as recited by
6 each of applicants' independent claims. While col. 5, line 60 – col. 6, line 1 of Boppart discloses that
7 "receiver processing unit 38 can consist of a single detector, dual-balanced detectors, or an array of
8 photo-detectors," and that "the receiver processing unit 38 includes photo-detectors which receive
9 signals from the sample and reference reflections and detect any optical interference," there is no
10 teaching of a photon detector that is configured to "receive light at a location that *is proximate to the*
11 *cantilever and to the support.*" Boppart fails to teach or suggest any light detector that responds to
12 light received at a location proximate to a cantilever or to a support for a cantilever.

13 On page 3 of the Office Action, the Examiner has indicated that single mode optical fiber 58
14 is equivalent to applicants' photon detector. During the interview, however, the Examiner indicated
15 that single mode optical fiber 58 encompasses the recitation of "a waveguide that conveys light from
16 the light source within the cantilever." However, applicants' photon detector is a separate element
17 from the cantilever, and Boppart's single mode optical fiber 58 cannot be treated as equivalent to
18 both a waveguide that conveys light from the light source within the cantilever, and a photon
19 detector.

20 Accordingly, for these additional reasons, Boppart does not anticipate or suggest all of the
21 recitation of Claim 1, and the rejection of Claim 1 as being anticipated by Boppart should be
22 withdrawn.

23 Since dependent claims inherently include all of the recitation of the independent claim on
24 which they ultimately depend, for at least the same reasons as noted above in connection with
25 independent Claim 1, the rejection of dependent Claims 2-5, and 8-19 should also be withdrawn.

26 Claims Rejected under 35 U.S.C. § 103(a)

27 Claims 6 and 7 remain rejected under 35 U.S.C. § 103(a) as being unpatentable over Boppart
28 in view of U.S. Patent No. 5,209,117 (Bennett). The Examiner acknowledges that Boppart does not
29 teach a tapered cantilever, but relies upon Bennett for teaching a micro-machined cantilever and for
30 teaching that tapered cantilevers are superior to rectangular cantilevers. However, Claims 6 and 7

ultimately depend from Claim 1 and are patentable for the reasons noted above. Thus, this rejection should be withdrawn.

Claims 20-24, 27-36, 38-40, 42-45, 47-56, and 58 remain rejected as unpatentable over Boppart in view of U.S. Patent No. 6,563,998 (Farah). In regard to Claim 27, the Examiner notes that it is a product by process claim and does not add any limitation to the structure of the cantilever.

Claims 25, 26, 41, 46, and 57 are rejected as unpatentable over Boppart in view of Farah, as applied to Claims 20 and 43, and further in view of Bennett. Applicants respectfully disagree for the reasons noted below.

Patentability of Claim 20

Significant differences exist between the recited subject matter and cited art because the cited art does not teach or suggest a photon detector as recited in subparagraph (e) and does not teach or suggest that the apparatus is configured as a micro-electro-mechanical system (MEMS) as recited in the preamble.

Like Claim 1, Claim 20 includes the recitation of a photon detector in subparagraph (e). Thus, for the reasons given above in the traversal of the rejection of Claim 1, applicants maintain that Boppart does not teach or suggest a photon detector.

In addition, under the section entitled "Response to Arguments" the Examiner maintains that the MEMS device of Farah can be modified by one of ordinary skill in the art to be used for scanning light relative to a target, since a MEMS device can be used to detect a difference in electrical potential in place of another sensor.

During the telephone interview, the Examiner explained that Farah does teach a MEMS aspect or that a MEMS is a piezo-electric device. But, the Examiner noted that piezo-electric devices are widely used and various sensors can be put in the MEMS device. Since Farah refers to this type of sensor, Examiner Shahrestani indicated that it would have been obvious to one skilled in the art.

However, applicants continue to respectfully disagree because Farah teaches away from the function of a MEMS cantilever for scanning relative to a target. Instead, Farah teaches driving a cantilever used in a Mach-Zehnder interferometer (see Example 1), or in an interferometric accelerometer or optical switch (see Example 2). Each of these examples are directed to entirely different functions for a MEMS waveguide device cantilever than the scanning function recited in applicants' claims.

1 Accordingly, it will be clear that Claim 20 also patentably distinguishes over the cited art for
2 these reasons, as well. Since dependent claims inherently include all that is recited in the
3 independent claim from which they ultimately depend, Claims 21-36 and 38-42 are patentable for at
4 least the same reasons as independent Claim 20.

5 Patentability of Claim 27

6 The Examiner has indicated that Claim 27 is merely a product by process claim and that the
7 process by which by the cantilever is formed does not add any limitation to the structure of the
8 cantilever itself. Applicants respectfully disagree. Claim 27 recites:

9 The apparatus of Claim 20, wherein the cantilever is formed by at least one of a deep
10 reactive ion etching, a photolithography, an electron beam lithography, and a wet
11 anisotropic etching of the substrate using a mask to define a shape of the cantilever.

12 Although Claim 27 is an apparatus claim, one of ordinary skill will appreciate that there are
13 numerous approaches in which cantilevers might be formed, such as by reactive ion etching,
14 photolithography, etc. Each of these ways of forming cantilevers inherently affects the resulting
15 characteristics of a cantilever. Thus, a cantilever formed, for example, by electron beam lithography,
16 will have inherent properties that differ from the properties of a cantilever formed by reactive ion
17 etching, as will be appreciated by one of ordinary skill in the art. Applicants respectfully submit that
18 this dependent claim therefore does further narrow the claim from which it depends by reciting how
19 the cantilever may be formed, each different approach recited resulting in a cantilever with at least
20 some inherent different properties. Claim 27 is therefore patentable.

21 Patentability of Claim 43

22 Significant differences exist between the recited subject matter and cited art because the cited
23 art does not teach or suggest the step of receiving light at a location that is proximate to a cantilever
24 and to a support, as recited in step (e) and does not teach or suggest using a micro-electro-mechanical
25 system (MEMS) for scanning the target, as recited in the preamble.

26 Step (e) of Claim 43 recites:

27 receiving light at a location that is proximate to the cantilever and to the support
28

29 As explained in connection with the traversal of the rejection of Claim 1, the cited art does not
30 teach or suggest receiving light at a location that is proximate to a cantilever and to a support.

1 In addition, for the reasons set forth with respect to applicants' traversal of the rejection of
2 Claim 20, the cited art does not teach or suggest using a micro-electro-mechanical system (MEMS) in
3 connection with scanning a target, as recited in the preamble of Claim 43.

4 Accordingly, Claim 43 is also novel and non-obvious over the cited art, and the rejection of
5 this claim should be withdrawn. Since dependent claims are patentable for at least the same reasons
6 as the independent claim on which they ultimately depend, Claims 44-58 are also patentable over the
7 cited art, and their rejection should be withdrawn.

8 Based upon the preceding Remarks, it should be clear that all claims remaining in the present
9 application are patentable over the art cited. This case should thus be passed to issue without further
10 delay. In the event that any question remains, the Examiner is asked to telephone applicants' attorney
11 at the number listed below.

12
13 Respectfully submitted,

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